

CLAIMS

What is claimed is:

1. An apparatus for irradiating surfaces comprising:
 - 5 an electron beam generator for generating a beam of electrons, the beam of electrons exiting the electron beam generator through an exit window; and
 - 10 a robotic device for moving the beam of electrons over the surfaces to irradiate selected regions of the surfaces, the robotic device including a propulsion system for propelling the robotic device.
2. The apparatus of Claim 1 in which the robotic device includes a robotic arm for maneuvering the electron beam generator.
3. The apparatus of Claim 2 in which the robotic device includes a horizontal rotary joint for swinging the robotic arm.
4. The apparatus of Claim 3 in which the robotic arm comprises:
 - 15 an upper arm member;
 - 20 a rotary shoulder joint rotatably coupled to the upper arm member for raising and lowering the robotic arm;
 - 25 a lower arm member rotatably coupled to the upper arm member by a rotary elbow joint, the elbow joint for raising and lowering the lower arm member relative to the upper arm member;
 - 30 a bracket rotatably coupled to the lower arm member by a rotary wrist joint, the wrist joint for swinging the bracket from side to side; and
 - 35 a rotary bracket joint rotatably coupling the electron beam generator to the bracket for rotating the electron beam generator.

5. The apparatus of Claim 1 in which the propulsion system comprises:
 - a first pair of rotatable wheels rotatably fixed and spaced apart from each other along a first axis, the first pair of wheels being rotatably driven; and
 - 5 a second pair of rotatable wheels spaced apart from each other along a second axis transverse to the first axis, the wheels of the second pair each being pivotably mounted and steerable.
6. The apparatus of Claim 5 in which the second pair of wheels is rotatably driven.
7. The apparatus of Claim 6 in which each wheel in the first and second pairs of rotatable wheels can be independently driven.
- 10 8. The apparatus of Claim 1 in which the robotic device moves along a track.
9. The apparatus of Claim 1 in which the robotic device is capable of controllably spacing the exit window of the electron beam generator a desired distance away from the surfaces as the electron beam generator is moved over the surfaces.
10. The apparatus of Claim 9 in which the robotic device is capable of continuously 15 and actively spacing the exit window of the electron beam generator the desired distance away from the surfaces.
11. The apparatus of Claim 10 in which the electron beam generator is hermetically sealed.
12. The apparatus of Claim 1 in which irradiating the surfaces includes any of 20 sterilization, decontamination, curing, destroying molecules and facilitating chemical reactions.

13. A method of irradiating surfaces comprising:
 - generating a beam of electrons with an electron beam generator, the beam of electrons exiting the electron beam generator through an exit window; and
 - 5 moving the beam of electrons over the surfaces with a robotic device to irradiate selected regions of the surfaces, the robotic device including a propulsion system for propelling the robotic device.
14. The method of Claim 13 further comprising maneuvering the beam of electrons over the surfaces with a robotic arm.
- 10 15. The method of Claim 14 further comprising swinging the robotic arm with a horizontal rotary joint.
16. The method of Claim 14 further comprising:
 - raising and lowering the robotic arm with a rotary shoulder joint coupled to an upper arm member of the robotic arm;
 - 15 raising and lowering a lower arm member of the robotic arm relative to the upper arm member by a rotary elbow joint rotatably coupling the lower arm member to the upper arm member;
 - swinging the electron beam generator from side to side with a rotary wrist joint rotatably coupling the lower arm member to a bracket housing the electron beam generator; and
 - 20 rotating the electron beam generator with a rotary bracket joint rotatably coupling the electron beam generator to the bracket.

17. The method of Claim 13 further comprising:
 - propelling the robotic device with a first pair of rotatable wheels rotatably fixed and spaced apart from each other along a first axis, the first pair of wheels being rotatably driven; and
 - 5 steering the robotic device with a second pair of rotatable wheels spaced apart from each other along a second axis transverse to the first axis, the wheels of the second pair each being pivotably mounted.
18. The method of Claim 17 further comprising rotatably driving the second pair of wheels.
- 10 19. The method of Claim 18 further comprising independently driving each wheel in the first and second pairs of rotatable wheels.
20. The method of Claim 13 further comprising moving the robotic device along a track.
21. The method of Claim 13 further comprising controllably spacing the exit window of the electron beam generator a desired distance away from the surfaces as the electron beam generator is moved over the surfaces.
- 15 22. The method of Claim 21 further comprising continuously and actively spacing the exit window of the electron beam generator the desired distance away from the surfaces.
- 20 23. The method of Claim 22 further comprising hermetically sealing the electron beam generator.

24. The method of Claim 13 further comprising irradiating the surfaces for any of sterilization, decontamination, curing, destroying molecules and facilitating chemical reactions.
25. A method of forming an apparatus for irradiating surfaces comprising:
 - 5 providing an electron beam generator for generating a beam of electrons, the beam of electrons exiting the electron beam generator through an exit window; and
 - 10 arranging a robotic device relative to the electron beam generator for moving the beam of electrons over the surfaces to irradiate selected regions of the surfaces, the robotic device including a propulsion system for propelling the robotic device.